U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

PIKMIKTALIK RIVER SALMON ESCAPEMENT ENUMERATION AND SAMPLING PROJECT, 2004

Annual Report for Study 04-105
Phase II

Timothy J. Kroeker and Karen Dunmall
Kawerak, Inc.
Division of Natural Resources
Fisheries Department
Box 948
Nome, Alaska 99762

April 2005

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

ABSTRACT

Much of the salmon subsistence harvest for the communities of Stebbins and St. Michael occurs on the Pikmiktalik River. The Pikmiktalik River is part of the Yukon Delta National Wildlife Refuge, and is the site of one of a few Federal subsistence fisheries in the Norton Sound area. Local residents strongly feel that availability of in- and post-season escapement information would improve management of these fishery resources. Kawerak, Inc., in cooperation with the Stebbins and St Michael IRAs, conducted a salmon escapement enumeration and sampling project on the Pikmiktalik River from June 18 to August 31, 2004. The information colleted provided baseline data regarding salmon abundance, run-timing and biological (age, sex, and length) data to the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game. Total estimated escapements were 225 Chinook *Oncorhynchus tshawytscha*, 8,051 chum *O. keta*, 50,621 pink *O. gorbuscha*, and 11,799 coho *O. kisutch* salmon. Additionally, a total of 616 Dolly Varden (*Salvelinus malma*) and 514 whitefish (*Coregonus* sp.) were recorded. Age, sex and length data collected from chum salmon indicated that the most abundant age class was 5-year-old salmon (produced by the 1999 brood year), which accounted for 47.9% of the total sample, representing 3,883 chum salmon of the estimated escapement. The ratio of male to female chum salmon was roughly 1:1. Males were generally longer than females, and older salmon were generally longer than younger ones for both chum and coho salmon. Of the coho sampled, 72% were male and 28% were female, while 83.6% of coho were age 2.1 and 14.3% were age 1.1. In August a 5-day flood event washed out the partial weir, made the water cloudy with silt and increased water depth too deep to count fish. Due to this high water event some coho salmon probably migrated past the tower and were not counted. Therefore, total coho salmon escapement on the Pikmiktalik River in 2004 is likely higher than that estimated in this escapement project. Continuation of this project in future years would provide valuable escapement data for use in management of these fisheries resources.

KEY WORDS: Pikmiktalik River, Yukon Delta National Wildlife Refuge, Escapement and Enumeration, chum salmon, *Oncorhynchus keta*, chinook salmon, *Oncorhynchus tshawytscha*, pink salmon, *Oncorhynchus gorbuscha*, salmon spawning, subsistence.

CITATION: Kroeker, T.J, and K. Dunmall. 2005. Pikmiktalik River Salmon Escapement Enumeration and Sampling Project, 2004. Annual Report for Study 02-020 Phase II. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Anchorage, Alaska.

INTRODUCTION

Much of Stebbins and St. Michael's subsistence harvest of salmon is on the salmon stocks of the Pikmiktalik River. However, until 2003 there were no projects to provide estimates of the number of Chinook, chum (summer and fall), pink or coho salmon entering this river to spawn. Local residents strongly feel that availability of in- and post-season escapement information would improve management of these fishery resources.

Stebbins Community Association received funding from the Native American Rights Fund to conduct surveys of local salmon systems during August 1995. Mr. Morris J. Coffey was the principal investigator for this work. Ground and aerial surveys to count salmon in the Pikmiktalik and Kogok Rivers were conducted with the use of boats and a helicopter. Test fishing was also done in the southern Norton Sound area for pink salmon. Information was sent to the Alaska Department of Fish and Game, Division of Commercial Fisheries, Area Office in Nome for use in the management of the salmon fisheries. U.S. Fish and Wildlife Service, National Park Service and Stebbins Community Association conducted a preliminary study (FIS 02-020) in 2002 to assess the feasibility of visually counting salmon and to select possible project sites (Lean et al. 2003). The salmon escapement enumeration and sampling project began in 2003 and was continued in 2004. The goal of this salmon escapement enumeration and sampling project is to obtain daily and annual estimates of salmon entering this system to improve management of important fishery resources for local subsistence users.

OBJECTIVES

The 2004 season represents the second year that Kawerak Inc. operated a salmon enumeration and sampling project on the Pikmiktalik River and the first year that coho were counted. The objectives for the 2004 season were as follows:

1. Install tower, weir and flash panel at the counting site.
2. Provide daily and total annual estimates of salmon passing the counting site.
3. Provide estimates of the age, sex, and length composition of chum and coho salmon passing the counting site.
4. Record weather and water conditions at the salmon counting site.

METHODS

Weir and tower installation occurred on June 16 and 17, 2004. The crew consisted of a Lead Fisheries Technician, and two Fisheries Technicians, an alternate Fisheries Technician was also hired to substitute when other Technicians took time off. Counting began on June 18, 2004 and continued until August 31, 2004. The utilized tower site was the preferred location identified by Lean et al. (2003; Figure 1).

Design and Construction

The counting tower apparatus consists of one 15-foot high scaffold tower. The tower had a counting platform at its uppermost level and was fastened to earth anchors for stability.

Construction and installation of this prefabricated, commercially available tower conformed to OSHA standards.

A partial diversion weir was constructed according to the standard portable weir design currently used in Norton Sound (Robb 1995) and consisted of steel tripod supports, aluminum stringers and schedule 40 aluminum structural pipe for pickets. To avoid possible toxic effects on fish and aquatic life galvanized pipe was not used. Picket spacing was approximately 2 5/8" and the weir was held up with a panel of steel fence posts connected with cable and sandbags placed on the river bottom. The panel slightly overlapped the toe of the picket weir and continued in a straight line to the bank on which the tower was placed. Cable clamps were periodically placed along the cable so that the fence posts remained spread out and the panel remained straight.

Installation and Operation

An observer counted salmon from the top of the tower for 20 minutes every hour, twenty four hours a day seven days a week. Numbers of salmon and other fish, by species, were recorded on a hand-tally counter. Salmon and other fishes passing downstream were subtracted from the count. Dead or dying fish drifting downstream past the counting site were not subtracted from 20-minute upstream counts, as they were not likely to swim upstream past the site again. Numbers from the hand tally counter were recorded in a logbook, and, at the end of the counting day, were expanded by 3 to estimate total passage for each hour. The 20-minute counting schedule occurred 24 hours a day, 7 days per week. The expanded daily count was transferred to a daily enumeration sheet and relayed to the Stebbins IRA office via radio the following day. Daily total salmon counts were submitted by radio and satellite phone to the Stebbins IRA office during weekdays and to the Kawerak, Inc. Fisheries Department on weekends. Kawerak, Inc. provided data to Alaska Department of Fish and Game and federal managers for their use and public distribution.

Care was taken to inspect, maintain, and clean debris, including salmon carcasses, from the weir on a regular basis. This ensured that fish could not pass through the weir undetected, and that debris load did not cause the weir to fail.

River stage height (cm), meteorological observations, and water temperatures (degrees C) were recorded at 0800 and 2000 hours each day. These data were entered on data sheets kept in a binder in the camp cabin.

Biological Sampling

Biological information was collected for chum and coho salmon. A pulse sampling design was used to collect this information for chum (Molyneaux and DuBois 1999). The sample size goal for each pulse was 200 chum. This sample size was selected so that simultaneous 95% confidence interval estimates of age composition proportions would be no wider than 0.20 (Bromaghin 1993). Recommended sample size was increased 9% to account for unreadable scales. Each pulse sample was used to estimate the age, sex, and length composition of the run for a given temporal stratum. A weighted mean, of chum salmon passage during each defined stratum as the weight, was used to estimate age composition of the total season passage. Biological information was also collected from a target sample size of 160 coho salmon. Chum and coho salmon were collected using beach seines. For each salmon sampled, sex was determined from external characteristics, length was measured to the nearest 0.5 cm from the

middle of the eye to the fork of the tail, and a scale was collected from left side. To avoid sampling the same salmon again, the adipose fin was removed prior to release.

Length summary statistics (mean, standard error, range) for each salmon species were reported by sampling stratum and age-sex category. The overall season mean was estimated by weighting stratum mean lengths by total passage of each species during that stratum.

Scales were collected from the left side of salmon, approximately two rows above the lateral line in the area crossed by a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). All scales removed were visually checked for damage and regeneration, and to make sure it was not taken from the lateral line, where scales would have pores or holes. If scales from the preferred area on left side of the salmon were missing, damaged, or regenerated, scales from the preferred area on the right side were collected. If scales could not be collected from the preferred area on either side of the fish, scales as close to the preferred area as possible were collected, and this was noted as "non-preferred scale" on the data sheet. Scales were mounted on gum cards with the insertion pointing down and to the right and the sculptured side facing out. All were initially recorded in a rite-in-the-rain field notebook and then transcribed onto data sheets in a binder kept in the camp cabin.

Scales were sent to Alaska Department of Fish and Game for age determination. Prior to examination, impressions of scales mounted on gum cards were made on cellulose acetate cards using a heated hydraulic press (Clutter and Whitesel 1956). Scale impressions on acetate cards were examined with microfiche readers. Ages were determined by examining scale characteristics (Mosher 1968). European notation was used to record ages (Koo 1962). In this system, a number preceding a decimal point refers to number of freshwater annuli and a number following the decimal refers to number of marine annuli. Total age, from time of egg deposition (often referred to as brood year) to time of capture, was the sum of these numbers plus one.

RESULTS

From June 18 to August 31, 2004, a total of 225 Chinook, 8,051 chum, 50,621 pink, and 11,799 coho salmon were estimated to have migrated past the tower site, in addition to 616 Dolly Varden and 514 whitefish (Table 1, Figure 2).

Chum salmon migrated past the tower from June 19 through the end of the project on August 31 (Table 1; Figures 2 and 3). Approximately 50% of the total migration occurred by July 12, and 98% by August 12. Greatest daily passage occurred on July 15, when 744 chum salmon were estimated to have moved upstream. Two other large abundance peaks occurred on June 28 (597 chum salmon), and July 12 (567 chum salmon). However, a net downstream movement of 48 chum salmon occurred on July 17.

A total of 301 chum salmon were sampled for age, sex, and length data, and 284 of these had usable scales for determination of age (Table 2). Estimated age composition of the total spawning escapement was 47.9% age-0.4, 41.5% age-0.3, and 10.2% age-0.2 chum salmon. Females represented 45.9% of the total spawning escapement. Samples were apportioned between three strata: June 29-July 6, July 11-July 15 and July 19-August 3. Sex composition generally was similar between stratum, with 54.3% females in the first, 48.7% in the second strata and 34.8% in the third strata. Age composition was similar between the stratum with age-0.4 chum representing 48.1% of the sample in the first strata, 47.4% in the second strata, and

47.8% in the third strata. Age-0.3 chum salmon represented 44.4% of the sample in the first strata, 34.2% in the second strata and 43.5% in the third strata. Age-0.2 chum salmon represented 6.8% of the sample in the first strata, 18.4% in the second strata and 8.7% in the third strata. Age composition was similar whether the data was weighted by strata or un-weighted. Generally, chum salmon length increased with age (mean length of age-0.2 chum salmon was 538mm, mean length of age-0.3 chum salmon was 578mm and mean length of age-0.4 chum salmon was 580mm). Males were larger than the females of similar age.

Chinook salmon migrated past the tower from June 22 to July 13, 2004 (Table 1; Figures 2 and 4). About 50% of the total migration occurred by June 29. The greatest daily passage occurred on June 29, when 42 Chinook salmon were estimated to have moved upstream. No net downstream movement of Chinook salmon occurred in 2004.

Pink salmon migrated past the tower from June 20 to August 31, 2004 (Table 1; Figures 2 and 5). About 50% of the total migration occurred by July 14 and greatest daily passage occurred on July 11 when 21,210 pink salmon were estimated to have moved upstream. No net downstream movement of pink salmon occurred in 2004.

Coho salmon migrated past the tower from July 26 through the end of the project, on August 31 (Table 1, Figures 2 and 6). Total estimated passage during this time was 11,799 coho salmon. The greatest daily passage of 1206 coho salmon occurred on August 6, and 50% of the total migration occurred by August 13. Age sex and length data was collected from 265 coho, and 189 of those scales were readable to determine age information. Estimated age composition of the total spawning escapement was 2.1% age-3.1, 83.6% age-2.1, and 14.3% age-1.1 coho salmon. Females represented only 28.0% of the total spawning escapement (Table 3). Generally, coho salmon length increased with age (mean length of age-1.1 coho salmon was 553 mm, mean length of age-2.1 coho salmon was 575mm, and mean length of age-3.1 coho salmon was 623mm). Males were generally larger than the females of similar age.

Dolly Varden and whitefish species were observed moving up- and downstream at the tower site throughout the season (Table 1). The greatest daily passage of Dolly Varden occurred on August 23 when 106 were estimated to have moved upstream. The greatest daily passage of whitefish occurred on and June 21 when 882 whitefish species were estimated to have moved downstream. Cumulative upstream passage for the season was 616 Dolly Varden and 514 whitefish.

Water temperature generally increased from June 30 to July 19, and then subsequently decreased to the end of the counting season (Table 4, Figure 7). Recorded water temperature ranged from 9^{o}C to 17^{o}C over the course of the season. Water temperatures measured at 2000 hours were generally higher than those measured at 0800 hours, and daily differences ranged from 0 to 4 ^{o}C.

Water depth did not show a strong trend over the course of the project, although depths were always greater at 0800 hours than at 2000 hours due to daily tidal influence at the tower site (Table 4, Figure 8). A one-week period (August 14 - August 21) of heavy rains did cause the river to flood and stopped counting operations due to a washed out partial weir and murky, deep water. It is believed that coho salmon passage did occur during this period of high water, however that migration is not reflected in the total coho salmon escapement because counting was not possible during this flood. Recorded water depths ranged from 30 to 175 cm over the course of the season. Daily fluctuations in water depth ranged from 10 to 130 cm.

DISCUSSION

The 2004 season represents the second time total estimates of chum, Chinook and pink salmon spawning escapements were obtained for the Pikmiktalik River, and the first time that coho salmon passage on the Pikmiktalik River was obtained. The project was also notable because an Alaska Native organization, Kawerak, Inc., in cooperation with the local tribal government, rather than a government agency, conducted the work. The project also trained and employed local residents as field technicians.

The project documented the entire Chinook and chum salmon runs on the Pikmiktalik River, however total coho escapement is likely higher than that estimated in this project. When the project began on June 18, no salmon were observed moving past the counting site. The set-up date was 1 day before the first Chinook was observed, 1 day before the first chum was observed, and 2 days before the first pink salmon was observed moving past the tower. When counting ended on August 31, daily numbers of chinook and chum salmon were less than 1% of their total runs, however coho salmon were still migrating past the tower. Generally, chum salmon traveled upstream in schools and seemed to be most abundant about 1 to 2 days after large high-tide events. Coho were also found to migrate after large amounts of precipitation, however coho numbers were generally strong throughout the latter half of the season. Due to a five-day flood event and the fact that the camp was shut down as of August 31, total upstream coho salmon passage is most likely underestimated.

The project was able to estimate numbers of chum salmon and sample chum salmon for age, sex and length as they migrated up the Pikmiktalik River. Of the estimated 8051 chum salmon that migrated past the tower, 68% of the run was completed by July 15 and 88% of the run was completed by July 31. Of the 284 chum salmon sampled, 47.8% were five years old, 40.4% were 4 years old and 11.7% were three years old. Higher numbers of five-year-old fish may indicate conditions in either the freshwater or marine system that delayed development or growth, and therefore resulted in a higher proportion of chum salmon returning to spawn as 5-year-old fish. Large numbers of three-year-old chum salmon may indicate that a large run of four-year-old chum salmon may occur in 2005. Only one six-year-old chum salmon was sampled in 2004, and its length was relatively small compared to the 4 and 5 year old chum salmon sampled. It was expected that 6-year-old chum salmon sampled would be larger, on average, than younger chum salmon given the longer marine development time of older salmon. Perhaps more six-year-old chum salmon will be sampled in future field seasons to further develop the relationship between age and length in older chum salmon.

Coho salmon were enumerated as they migrated upstream and a proportion was sampled for age, sex and length information. Of the 189 salmon coho sampled for age, sex and length, 72% were male and 28% were female. The large difference in the sex ratio of coho salmon may be due to a potential early run timing of male coho salmon and late run timing of female coho salmon. Coho sex ratios have been found to vary in other locations. For instance, on the Columbia River where sex ratios were 1:1, coho males were found to return earlier in the run (Marr 1943). Some coho sex ratios have been found to have larger male returns throughout the run ranging from 1.2:1 (Logan 1967) to 2.07:1(Hunter 1949). Further investigation in future years will make coho salmon run timing and sex ratios clearer by attempting to count throughout the run. The majority of coho sampled were 4-year-old fish (83.6%), while 14.3% of the coho sampled were 3 years old and 2.1% were 5 years old. The age composition found in Pikmiktalik River coho salmon is common throughout the region.

Whitefish were observed moving past the tower regularly on the Pikmiktalik River. Greater numbers of whitefish were observed moving downstream at the beginning of the season, and were observed in smaller numbers migrating upstream in the last weeks of the project. Although the original proposal did not include enumeration of whitefish, technicians were first trained in counting fish from the tower by observing the movements of the whitefish, which was the only species present when operations began. This data may be useful since whitefish are an important fisheries resource to local communities.

Dolly Varden were also observed passing the tower in 2004. Dolly Varden were sparse throughout the season, with the exception of August 23 when 106 Dolly Varden migrated upstream past the tower. This migration was observed two days after a major flood event and may have been influenced by the water conditions due to the flood.

The Pikmiktalik River is located in the Yukon Delta National Wildlife Refuge and is the site of one of only a few Federal managed fisheries in the Norton Sound area. Management should use escapement data from the Pikmiktalik River as a foundation for decisions to ensure sustainability of these salmon runs. Additional years of escapement data will provide abundance trend information as well as some indication of production. The residents of Stebbins and St. Michael have long been concerned with the absence of salmon monitoring on the rivers they use for subsistence fishing. Therefore, they were very pleased with this project on the Pikmiktalik River, and have offered several ideas for future projects, including studies about the effects of beaver on salmon migration.

CONCLUSIONS

Operations in 2004 proved once again that it is possible to enumerate Chinook, chum, pink salmon escapement, and also coho salmon escapement into the Pikmiktalik River using a partial diversion weir and counting tower at the selected site. The success of the 2004 enumeration project was due to the productive collaboration of Stebbins IRA, St. Michael IRA, and Kawerak, Inc. Stebbins IRA effectively and efficiently administered day-to-day operations of the field camp. This created a positive camp environment for the technicians, who were able to remain focused and ambitious throughout the season and to collect and record highly accurate data. Hiring local residents as field technicians also provided a valuable source of traditional knowledge of the area. Kawerak, Inc. was able to provide the technical and administrative expertise needed for overall planning, operations, data analysis, and reporting.

RECOMMENDATIONS

1. Salmon enumeration studies on the Pikmiktalik River should continue for future years to obtain data on abundance and production.
2. The project should be operated through mid-September to obtain information on the entire coho salmon run.
3. Public information needs to be improved in St. Michael and Stebbins regarding activities at the Pikmiktalik River counting site. This could be done through the use of radio announcements, newspaper articles, and posters in stores and other public places.

ACKNOWLEDGEMENTS

The Kawerak, Inc. Fisheries Program would like to thank Morris Nashoanak for his time and effort coordinating camp supplies, personnel, and data management. The help of Charlie Lean with the National Parks Service and Stephen Fried with U.S. Fish and Wildlife Service is also greatly appreciated. The Lead Fisheries Technician, Kellen Katcheak, and Fisheries Technicians, Danny Nashoanak, Ryan Nashoanak, Justin Katcheak and Rennie Jack, did outstanding work with minimum supervision to ensure the success of this project. Expertise and some project materials were provided by the Alaska Department of Fish and Game, with special thanks to Jim Menard, Wes Jones, and Gary Knuefer. Morris Nashoanak provided, and Ryan Nashoanak operated, the boat and motor used to transport supplies and personnel to and from camp. We greatly appreciate the cooperation of Andrew Foxie Sr., for allowing use of his cabin by the technicians, and Austin Mathias, for allowing use of his land as the counting site. The U.S. Fish and Wildlife Service, Office of Subsistence Management, provided $116,466 in funding support for this project through the Fisheries Resource Monitoring Program, under contract number 7010132253.

LITERATURE CITED

Bromaghin, J.F. 1993. Sample size determination for interval estimation of multinomial probabilities. The American Statistician. 47(3): 203-206.

Clutter, R., and L. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Bulletin of the International Pacific Salmon Fisheries Commission No. 9. Vancouver British Columbia.INPFC (International North Pacific Fisheries Commission). 1963. Annual Report, 1961. Vancouver, British Columbia.

Hunter, J.G. 1949. Natural propagation of salmon in the central coastal area of British Columbia. II. The 1948 run. Fish. Res. Board Can. Prog. Rep. Pac. Coast Stn. 79:33-34. As reported in the Pacific Salmon Life Histories.

INPFC (International North Pacific Fisheries Commission). 1963. Annual Report, 1961. Vancouver, British Columbia.

Koo, T. S. Y. 1962. Age designation in salmon. Pages 37-48 *in* T. S. Y. Koo, editor. Studies of Alaska red salmon. University of Washington Publications in Fisheries, New Series, Volume I, Seattle.

Lean, C. D. Wiswar, T. Roettiger, and S. Fried. 2003. Pikmiktalik River Salmon Counting Site Surveys. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report for Study 02-020, Anchorage, Alaska.

Logan, S.M. 1967. Silver salmon studies in the Resurrection Bay area. Prog. Rep. Alaska Dep. Fish Game Sport Fish Div. 9(1966-67):83-102. As reported in the Pacific Salmon Life Histories.

Marr, J.C. 1943. Age, length and weight studies of three species of Columbia River salmon (*Oncorhynchus keta, O. gorbuscha, and O. kisutch*). Stanford Ichthyol. Bull. 2:157-197. As cited in the Pacific Salmon Life Histories.

Molyneaux, D. B. and L. DuBois. 1999. Salmon age, sex, and length catalog for the Kuskokwim area, 1998 progress report. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A99-15, Anchorage.

Mosher, K.H. 1968. Photographic atlas of sockeye salmon scales. U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Bulletin 2:243-274.

Robb, P.J. 1995. Niukluk River salmon counting tower project summary report 1995. Alaska Department of Fish and Game, Commercial Fish Division, Anchorage Regional Informational Report No. 3A97-04.

Table 1. Estimated daily and cumulative numbers of all fish species, and cumulative proportions of coho and pink salmon migrating past Pikmiktalik River Tower in 2004.

	Number															
	Daily						Cumulative						Cumulative Proportion			
Date	Chinook	Chum	Pink	Coho	Dolly	Whitefish	Chinook	Chum	Pink	Coho	Dolly	Whitefish	Chinook	Chum	Pink	Coho
18-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
19-Jun	9	12	0	0	0	0	9	12	0	0	0	0	0.04	0.00	0.00	0.00
20-Jun	0	21	42	0	33	-213	9	33	42	0	33	-213	0.04	0.00	0.00	0.00
21-Jun	0	39	60	0	9	-144	9	72	102	0	42	-357	0.04	0.01	0.00	0.00
22-Jun	3	21	39	0	21	-93	12	93	141	0	63	-450	0.05	0.01	0.00	0.00
23-Jun	0	30	66	0	15	-66	12	123	207	0	78	-516	0.05	0.02	0.00	0.00
24-Jun	12	21	87	0	6	30	24	144	294	0	84	-486	0.11	0.02	0.01	0.00
25-Jun	6	117	72	0	12	-42	30	261	366	0	96	-528	0.13	0.03	0.01	0.00
26-Jun	0	6	54	0	3	-18	30	267	420	0	99	-546	0.13	0.03	0.01	0.00
27-Jun	6	159	297	0	-6	33	36	426	717	0	93	-513	0.16	0.05	0.01	0.00
28-Jun	30	597	1350	0	15	15	66	1023	2067	0	108	-498	0.29	0.13	0.04	0.00
29-Jun	42	474	2292	0	15	-51	108	1497	4359	0	123	-549	0.48	0.19	0.09	0.00
30-Jun	15	210	2262	0	9	-9	123	1707	6621	0	132	-558	0.55	0.21	0.13	0.00
1-Jul	3	78	984	0	-3	27	126	1785	7605	0	129	-531	0.56	0.22	0.15	0.00
2-Jul	3	315	2448	0	0	12	129	2100	10053	0	129	-519	0.57	0.26	0.20	0.00
3-Jul	3	111	849	0	9	-27	132	2211	10902	0	138	-546	0.59	0.27	0.22	0.00
4-Jul	3	30	237	0	15	3	135	2241	11139	0	153	-543	0.60	0.28	0.22	0.00
5-Jul	3	141	381	0	39	27	138	2382	11520	0	192	-516	0.61	0.30	0.23	0.00
6-Jul	24	90	411	0	-39	18	162	2472	11931	0	153	-498	0.72	0.31	0.24	0.00
7-Jul	12	324	831	0	12	-51	174	2796	12762	0	165	-549	0.77	0.35	0.25	0.00
8-Jul	6	255	546	0	-6	72	180	3051	13308	0	159	-477	0.80	0.38	0.26	0.00
9-Jul	3	123	2256	0	-3	6	183	3174	15564	0	156	-471	0.81	0.39	0.31	0.00
10-Jul	18	372	3003	0	3	72	201	3546	18567	0	159	-399	0.89	0.44	0.37	0.00
11-Jul	9	258	2643	51	48	12	210	3804	21210	51	207	-387	0.93	0.47	0.42	0.00
12-Jul	12	567	7518	24	9	36	222	4371	28728	75	216	-351	0.99	0.54	0.57	0.01
13-Jul	3	87	852	12	9	0	225	4458	29580	87	225	-351	1.00	0.55	0.58	0.01
14-Jul	0	234	85	0	9	48	225	4692	29665	87	234	-303	1.00	0.58	0.59	0.01
15-Jul	0	744	4899	0	3	3	225	5436	34564	87	237	-300	1.00	0.68	0.68	0.01
16-Jul	0	80	1446	9	0	18	225	5516	36010	96	237	-282	1.00	0.69	0.71	0.01
17-Jul	0	-48	813	0	0	21	225	5468	36823	96	237	-261	1.00	0.68	0.73	0.01
18-Jul	0	25	2046	16	0	21	225	5493	38869	112	237	-240	1.00	0.68	0.77	0.01
19-Jul	0	84	402	12	3	51	225	5577	39271	124	240	-189	1.00	0.69	0.78	0.01
20-Jul	0	162	1251	6	0	7	225	5739	40522	130	240	-182	1.00	0.71	0.80	0.01
21-Jul	0	195	1245	0	33	12	225	5934	41767	130	273	-170	1.00	0.74	0.83	0.01
22-Jul	0	165	936	3	0	15	225	6099	42703	133	273	-155	1.00	0.76	0.84	0.01
23-Jul	0	120	567	3	15	3	225	6219	43270	136	288	-152	1.00	0.77	0.85	0.01
24-Jul	0	357	1749	0	6	27	225	6576	45019	136	294	-125	1.00	0.82	0.89	0.01
25-Jul	0	168	1935	0	-3	45	225	6744	46954	136	291	-80	1.00	0.84	0.93	0.01
26-Jul	0	51	660	3	0	9	225	6795	47614	139	291	-71	1.00	0.84	0.94	0.01
27-Jul	0	15	114	9	0	-6	225	6810	47728	148	291	-77	1.00	0.85	0.94	0.01
28-Jul	0	78	294	45	18	9	225	6888	48022	193	309	-68	1.00	0.86	0.95	0.02
29-Jul	0	75	216	12	12	45	225	6963	48238	205	321	-23	1.00	0.86	0.95	0.02
30-Jul	0	108	405	39	3	57	225	7071	48643	244	324	34	1.00	0.88	0.96	0.02
31-Jul	0	42	114	36	30	-30	225	7113	48757	280	354	4	1.00	0.88	0.96	0.02
1-Aug	0	42	207	54	12	6	225	7155	48964	334	366	10	1.00	0.89	0.97	0.03
2-Aug	0	60	117	33	9	39	225	7215	49081	367	375	49	1.00	0.90	0.97	0.03
3-Aug	0	57	120	150	9	18	225	7272	49201	517	384	67	1.00	0.90	0.97	0.04
4-Aug	0	51	123	66	-3	-27	225	7323	49324	583	381	40	1.00	0.91	0.97	0.05
5-Aug	0	99	75	252	15	-27	225	7422	49399	835	396	13	1.00	0.92	0.98	0.07
6-Aug	0	120	162	939	21	21	225	7542	49561	1774	417	34	1.00	0.94	0.98	0.15
7-Aug	0	24	96	173	18	-33	225	7566	49657	1947	435	1	1.00	0.94	0.98	0.17
8-Aug	0	9	81	252	0	-6	225	7575	49738	2199	435	-5	1.00	0.94	0.98	0.19
9-Aug	0	87	180	282	18	33	225	7662	49918	2481	453	28	1.00	0.95	0.99	0.21

Table 1 continued.

	Daily						Cumulative						Cumulative Proportion			
Date	Chinook	Chum	Pink	Coho	Dolly	Whitefish	Chinook	Chum	Pink	Coho	Dolly	Whitefish	Chinook	Chum	Pink	Coho
10-Aug	0	126	180	826	0	33	225	7788	50098	3307	453	61	1.00	0.97	0.99	0.28
11-Aug	0	36	114	582	0	-15	225	7824	50212	3889	453	46	1.00	0.97	0.99	0.33
12-Aug	0	36	177	1206	3	39	225	7860	50389	5095	456	85	1.00	0.98	1.00	0.43
13-Aug	0	6	84	747	6	36	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
14-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
15-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
16-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
17-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
18-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
19-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
20-Aug	0	0	0	0	0	0	225	7866	50473	5842	462	121	1.00	0.98	1.00	0.50
21-Aug	0	93	0	507	0	72	225	7959	50473	6349	462	193	1.00	0.99	1.00	0.54
22-Aug	0	50	12	1113	9	72	225	8009	50485	7462	471	265	1.00	0.99	1.00	0.63
23-Aug	0	18	24	853	106	24	225	8027	50509	8315	577	289	1.00	1.00	1.00	0.70
24-Aug	0	9	0	577	3	96	225	8036	50509	8892	580	385	1.00	1.00	1.00	0.75
25-Aug	0	0	6	307	6	21	225	8036	50515	9199	586	406	1.00	1.00	1.00	0.78
26-Aug	0	3	16	122	12	30	225	8039	50531	9321	598	436	1.00	1.00	1.00	0.79
27-Aug	0	0	15	504	6	15	225	8039	50546	9825	604	451	1.00	1.00	1.00	0.83
28-Aug	0	0	6	813	9	9	225	8039	50552	10638	613	460	1.00	1.00	1.00	0.90
29-Aug	0	0	12	477	0	30	225	8039	50564	11115	613	490	1.00	1.00	1.00	0.94
30-Aug	0	6	27	327	0	15	225	8045	50591	11442	613	505	1.00	1.00	1.00	0.97
31-Aug	0	6	30	357	3	9	225	8051	50621	11799	616	514	1.00	1.00	1.00	1.00

Table 2. Age, sex, and length of chum salmon sampled, and estimated contribution to spawning escapement, Pikmiktalik River, 2004.

		Brood Year and Age Group				
		2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	Total
Sampling Date(s):	6/29-7/06					
Sample Size:	162					
Male	Percent of Sample	2.5	22.8	19.8	0.6	45.7
	Number in Escapement	61	565	488	15	1129
	Average Length (mm)	547.5	599.0	623.8	580.0	606.3
Female	Percent of Sample	4.3	21.6	28.4	0.0	54.3
	Number in Escapement	107	534	702	0	1343
	Average Length (mm)	520.0	555.4	567.6	0.0	558.7
Total	Percent of Sample	6.8	44.4	48.1	0.6	100.0
	Number in Escapement	168	1099	1190	15	2472
	Average Length (mm)	530.0	578.1	590.6	580.0	580.8
Sampling Date(s):	7/11-7/15					
Sample Size:	76					
Male	Percent of Sample	6.6	19.7	25.0	0.0	51.3
	Number in Escapement	195	585	741	0	1521
	Average Length (mm)	566.0	600.7	613.7	0.0	603.8
Female	Percent of Sample	11.8	14.5	22.4	0.0	48.7
	Number in Escapement	351	429	663	0	1443
	Average Length (mm)	532.8	546.4	575.3	0.0	555.5
Total	Percent of Sample	18.4	34.2	47.4	0.0	100.0
	Number in Escapement	546	1014	1404	0	2964
	Average Length (mm)	544.6	577.9	595.6	0.0	580.5
Sampling Date(s):	7/19-8/03					
Sample Size:	46					
Male	Percent of Sample	8.7	26.1	30.4	0.0	65.2
	Number in Escapement	227	682	796	0	1705
	Average Length (mm)	535.0	601.7	616.4	0.0	599.1
Female	Percent of Sample	0.0	17.4	17.4	0.0	34.8
	Number in Escapement	0	455	455	0	910
	Average Length (mm)	0.0	548.8	570.0	0.0	556.5
Total	Percent of Sample	8.7	43.5	47.8	0.0	100.0
	Number in Escapement	227	1137	1251	0	2615
	Average Length (mm)	535.0	580.5	599.5	0.0	584.6

Table 2. Continued

		Brood Year and Age Group				
		2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	Total
Sampling Date(s):	Season (Weighted by Strata)	Season Total				
Sample Size:	284					
Male	Percent of Sample	6.0	22.8	25.2	0.2	54.1
	Number in Escapement	483	1832	2025	15	4356
	Average Length (mm)	550.8	600.2	619.2	580.0	604.1
Female	Percent of Sample	5.7	17.6	22.6	0.0	45.9
	Number in Escapement	458	1418	1820	0	3695
	Average Length (mm)	527.2	552.6	569.7	0.0	557.6
Total	Percent of Sample	11.7	40.4	47.8	0.2	100.0
	Number in Escapement	941	3250	3845	15	8051
	Average Length (mm)	537.8	578.4	593.4	580.0	581.3

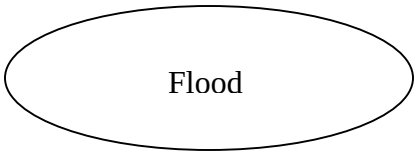
Sampling Date(s):	Season (Un-weighted)	Season Total				
Sample Size:	284					
Male	percent of sample	4.6	22.5	22.9	0.4	50.4
	Number in Escapement	369	1814	1843	28	4054
Female	percent of sample	5.6	19.0	25.0	0.0	49.6
	Number in Escapement	454	1531	2013	0	3997
Total	percent of sample	10.2	41.5	47.9	0.4	100.0
	Number in Escapement	822	3345	3855	28	8051

Table 3. Age, sex, and length of coho salmon sampled, and estimated contribution to spawning escapement, Pikmiktalik River, 2004.

		Brood Year and Age Group			
		2001	2000	1999	
		1.1	2.1	3.1	Total
Sampling Dates:	8/03-8/30				
Sample Size:	189				
	Percent of Sample	10.1	59.8	2.1	72.0
Male	Number in Escapement	1186	7054	250	8490
	Average Length (mm)	550.0	577.3	622.5	574.8
	Percent of Sample	4.2	23.8	0.0	28.0
Female	Number in Escapement	499	2809	0	3309
	Average Length (mm)	560.0	569.6	0.0	568.1
	Percent of Sample	14.3	83.6	2.1	100.0
Total	Number in Escapement	1686	9864	250	11799
	Average Length (mm)	553.0	575.1	622.5	572.9

Table 4. Daily water temperature and depth measured at 0800 (AM) and 2000 (PM) hours at Pikmiktalik River tower site, 2004.

	Temperature (°C)		Depth (cm)			Temperature (°C)		Depth (cm)	
Date	AM	PM	AM	PM	Date	AM	PM	AM	PM
18-Jun					26-Jul	14	14	60	32
19-Jun					27-Jul	13	14	74	32
20-Jun	11	14	125	40	28-Jul	13	14	117	36
21-Jun	12	13	107	40	29-Jul	13	16	130	36
22-Jun	11	11	115	40	30-Jul	14	16	122	36
23-Jun	10	11	85	42	31-Jul	15	15	164	37
24-Jun	9	11	89	53	1-Aug	14	13	171	36
25-Jun	10	12	68	90	2-Aug	12	14	119	35
26-Jun					3-Aug	13	14	96	34
27-Jun	12	16	68	44	4-Aug	13	15	58	35
28-Jun	13	17	60	42	5-Aug	12	16	36	36
29-Jun	14	16	111	40	6-Aug	12	16	36	32
30-Jun	12	14	104	40	7-Aug	13	13	60	32
1-Jul	12	12	141	40	8-Aug	12	13	60	46
2-Jul	12	13	124	40	9-Aug	13	14	81	37
3-Jul	12	13	124	40	10-Aug	12	16		38
4-Jul	12	13	120	40	11-Aug	13	15	97	42
5-Jul	12	15	80	40	12-Aug	13	13	104	43
6-Jul	12	14	59	38	13-Aug	13	14	153	65
7-Jul	10	14	64	39	14-Aug	13	13	175	93
8-Jul	12	13	37	30	15-Aug				
9-Jul	12	16	43	35	16-Aug				
10-Jul	12	16	54	34	17-Aug				
11-Jul	13	17	89	31	18-Aug				
12-Jul	13	17	100	36	19-Aug				
13-Jul	15	17	115	30	20-Aug				
14-Jul	14	17	144	33	21-Aug	13	15	63	75
15-Jul	14	15	138	34	22-Aug	13	15	50	50
16-Jul	15	15	138	32	23-Aug	12	15	59	45
17-Jul	14	15	155	32	24-Aug	12	15	65	45
18-Jul	14	15	137	35	25-Aug	12	14	80	45
19-Jul	14	17	90	36	26-Aug	11	12	73	45
20-Jul	14	15	100	35	27-Aug	10	12	50	45
21-Jul	13	17	70	35	28-Aug	9	11	78	43
22-Jul	14	16	70	30	29-Aug	10	11	80	42
23-Jul	14	16	57	30	30-Aug	10	12	80	39
24-Jul	13	17	59	32	31-Aug	10	11	83	38
25-Jul	14	17	66	32					



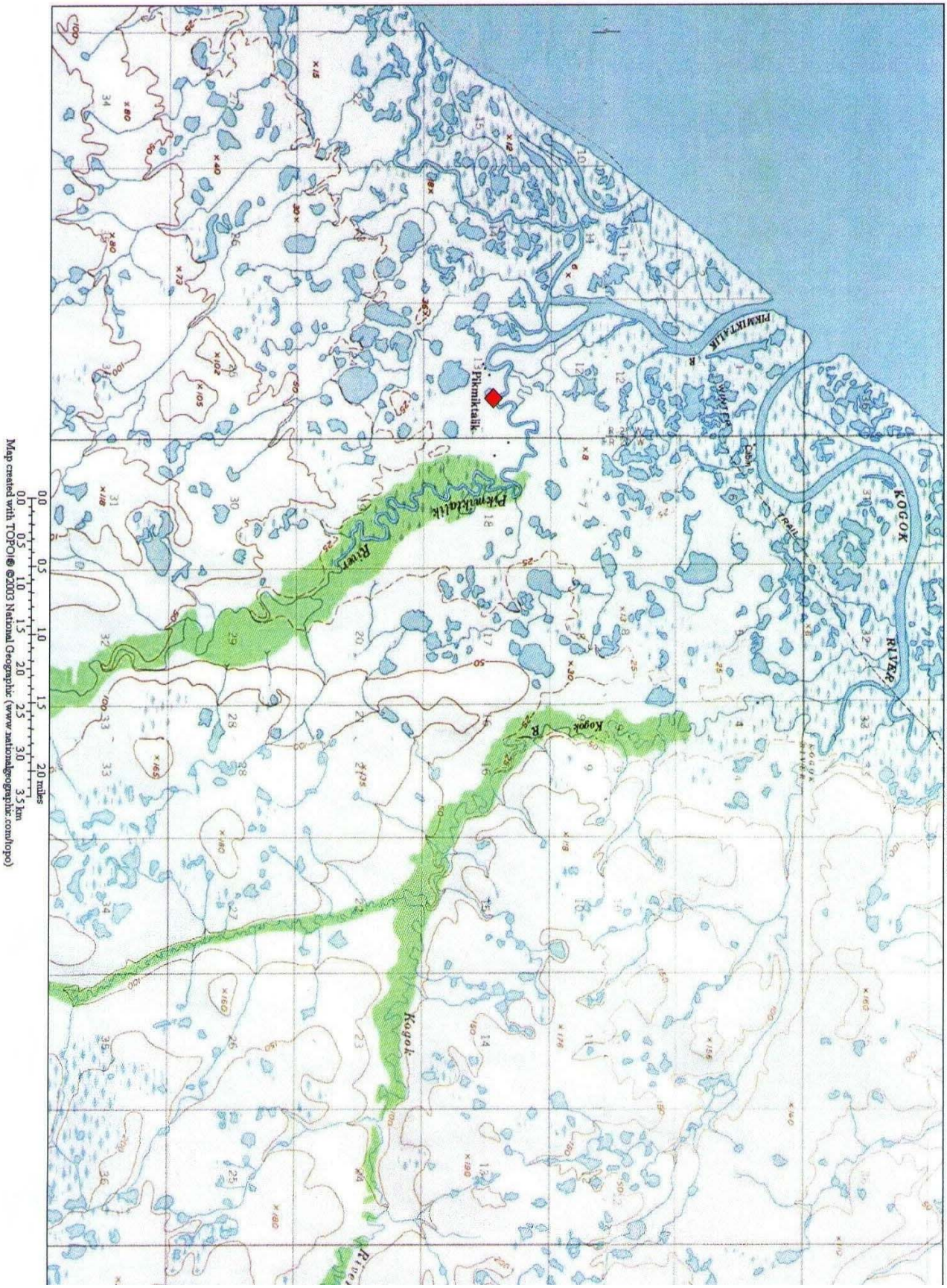


Figure 1. Location of the Pikmiktalik River salmon enumeration site.

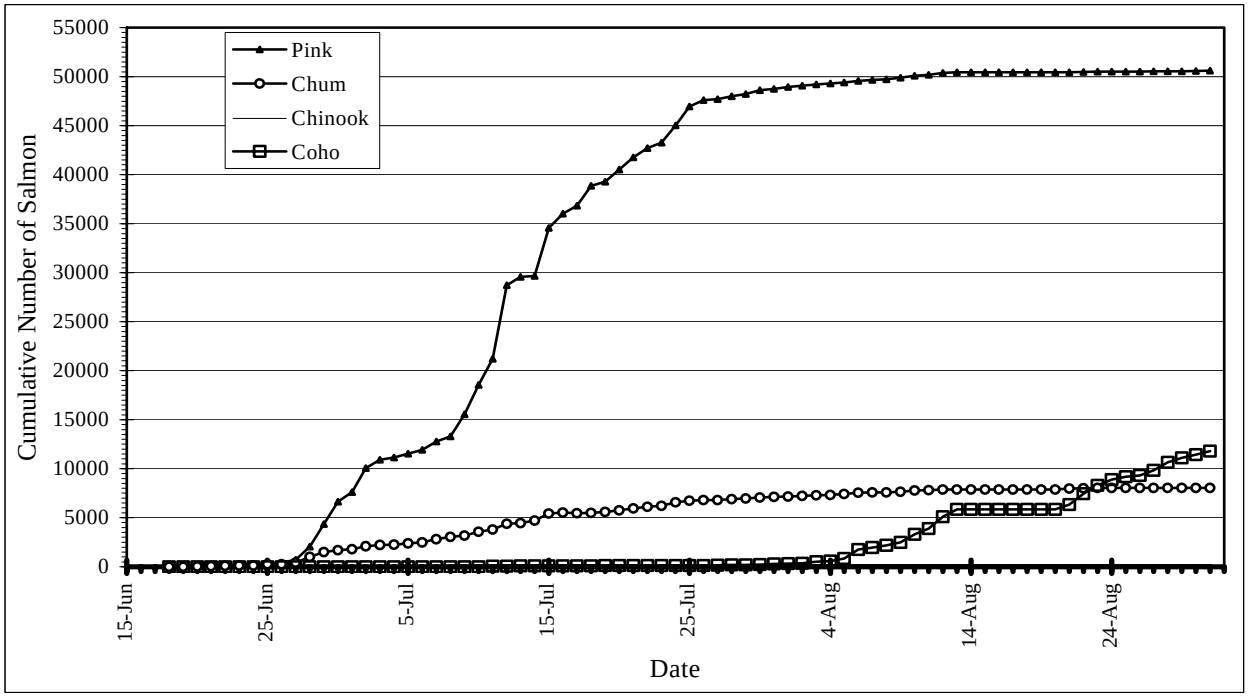


Figure 2. Cumulative number of chinook, chum, pink and coho salmon migrating past Pikmiktalik River tower site, 2004.

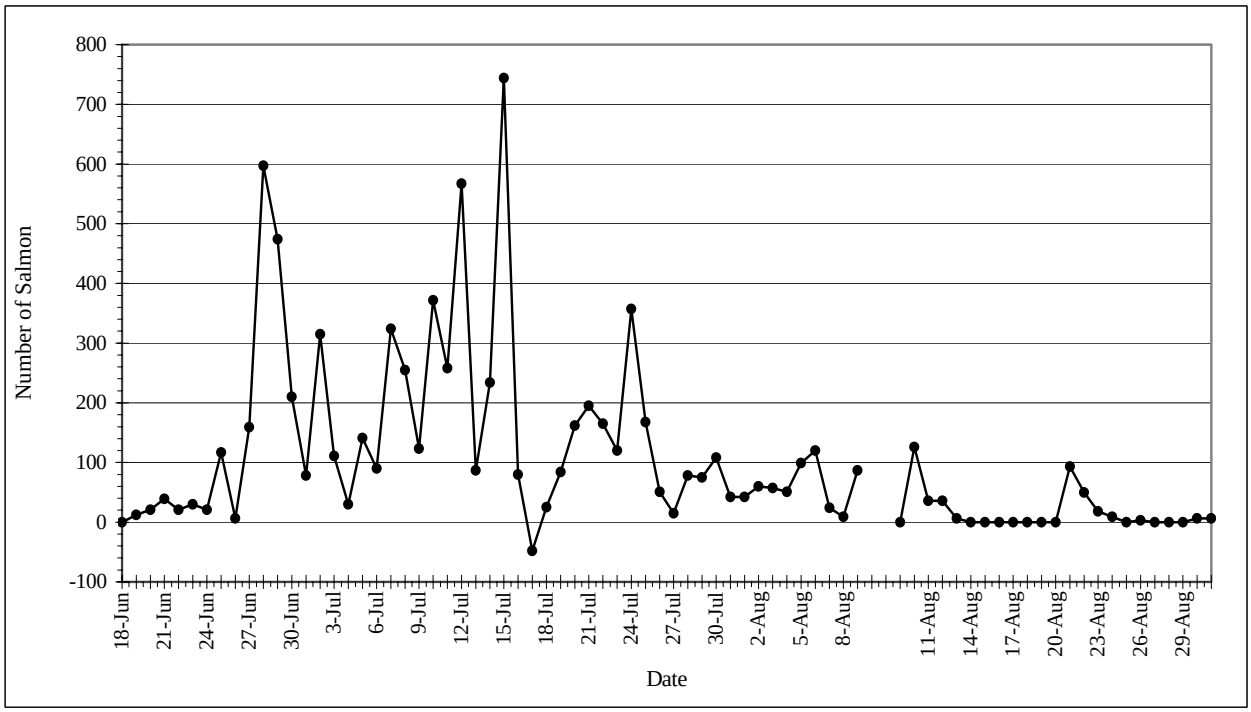


Figure 3. Daily movement of chum salmon at Pikmiktalik River tower site, 2004. A negative number indicates net downriver movement for that day.

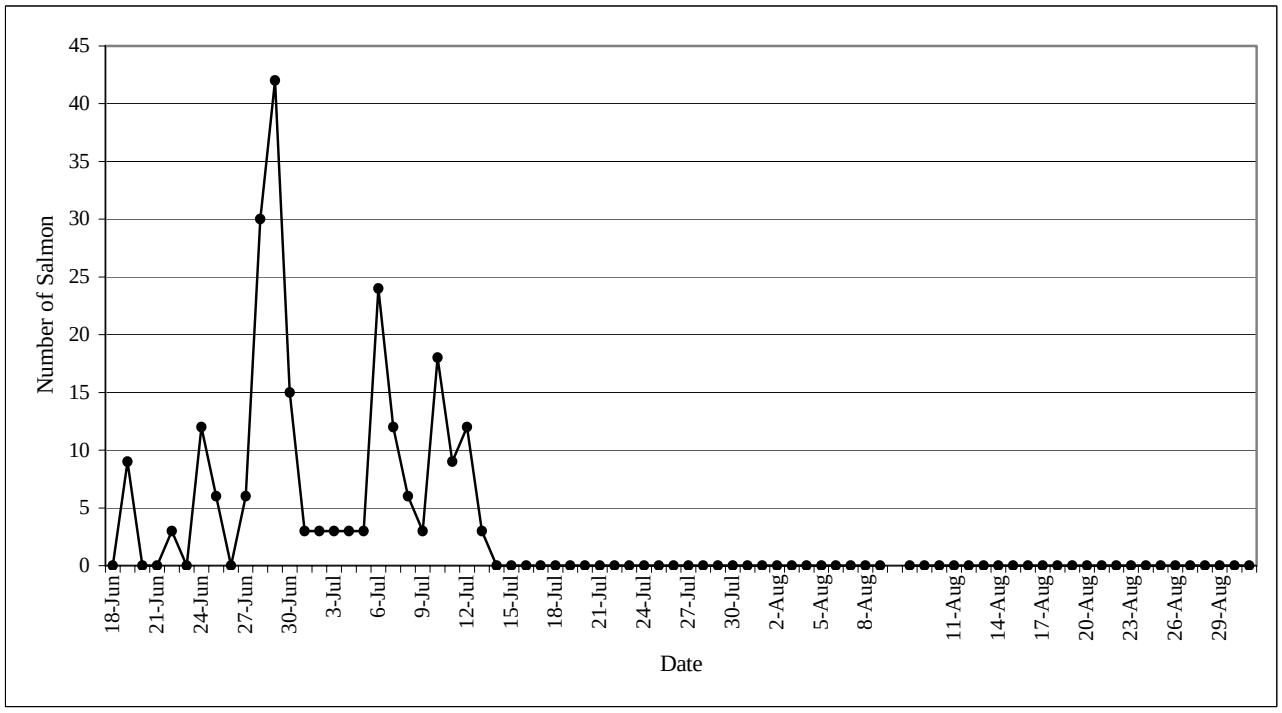


Figure 4. Daily movements of chinook salmon at Pikmiktalik River tower site, 2004.

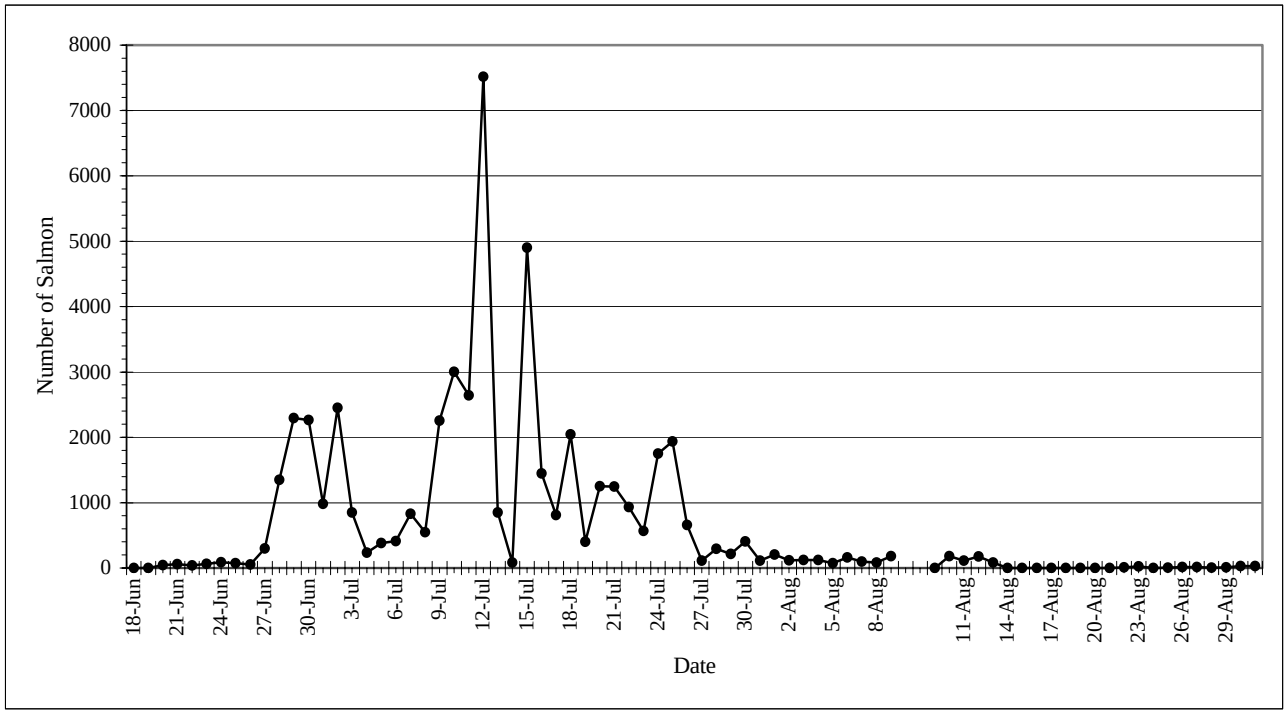


Figure 5. Daily movements of pink salmon at Pikmiktalik River tower site 2004.

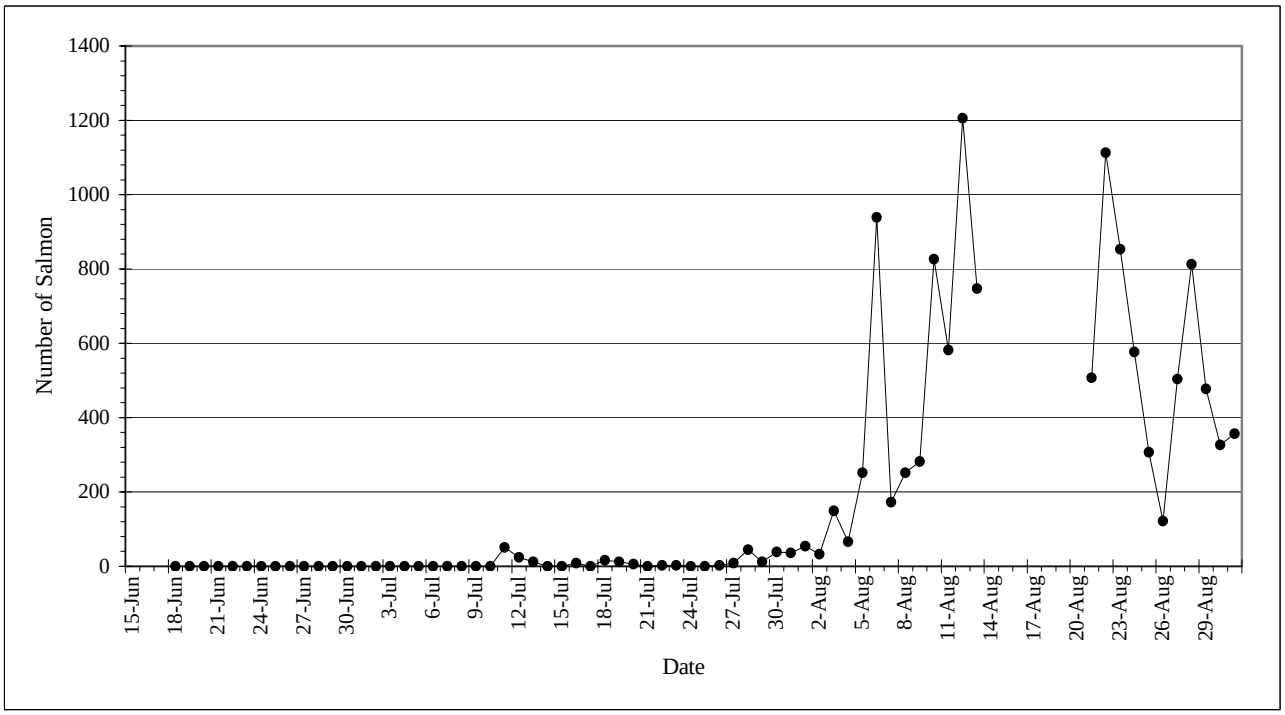


Figure 6. Daily movements of coho salmon at Pikmiktalik River tower site 2004.

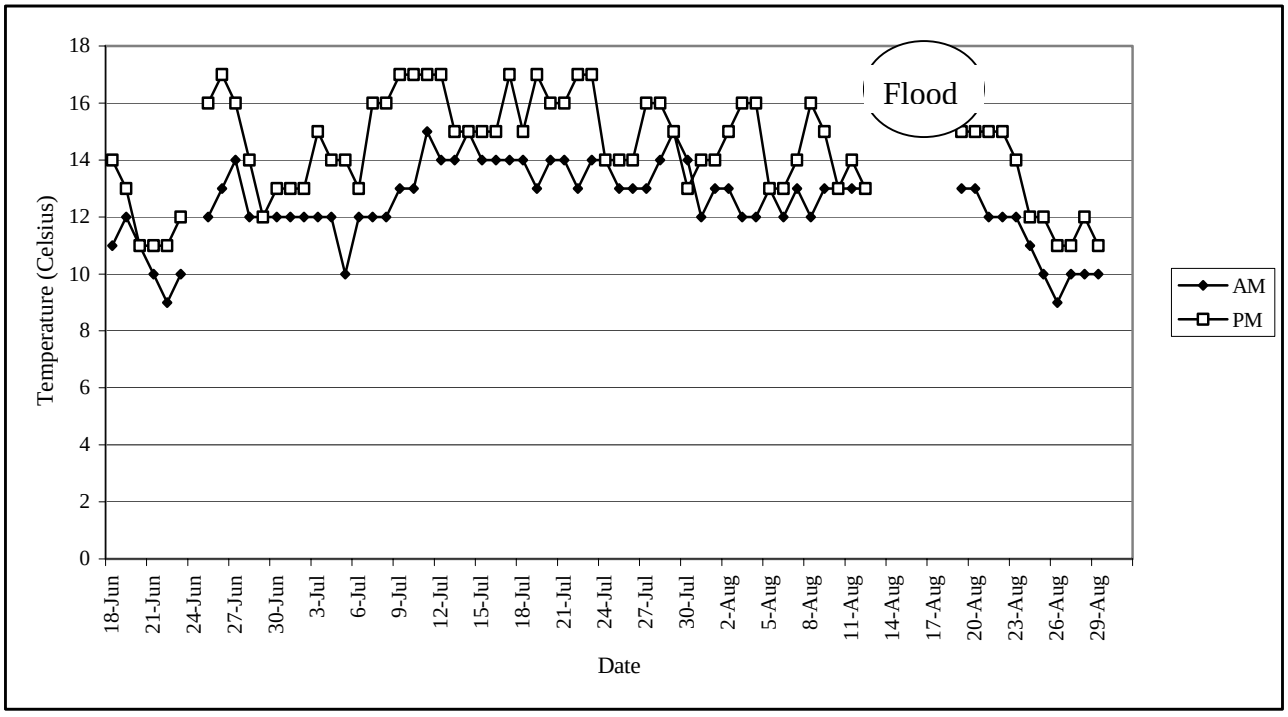


Figure 7. Water temperature recorded at 0800 (AM) and 2000 (PM) hours each day at Pikmiktalik River tower site, 2004.

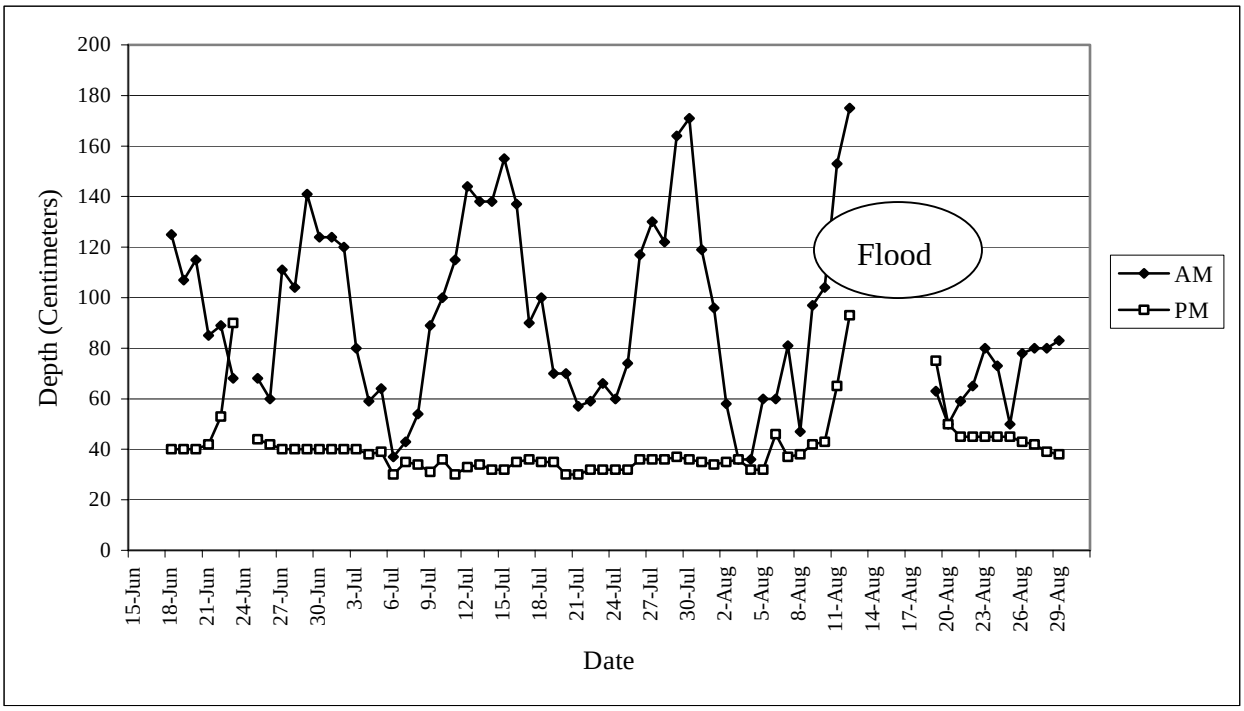


Figure 8. Water depth recorded at 0800 (AM) and 2000 (PM) hours each day at Pikmiktalik River tower site, 2004.

Appendix 1. Pikmiktalik River daily escapement counts from June 18, to August 31, 2004.

		Expanded counts							Water Temp		Gage (cm)		
Date	**hours**	**hours**	Chinook	Chum	Pink	Coho	Dolly	Whitefish	**AM**	**PM**	**Max**	**Min**	**Comments**
06/18/04	16	16	0	0	0	0	0	0	-	-	-	-	
06/19/04	24	24	9	12	0	0	0	0	-	-	-	-	
06/20/04	24	24	0	21	42	0	33	-213	11	14	125	40	
06/21/04	22	24	0	39	60	0	9	-144	12	13	107	40	
06/22/04	22	24	3	21	39	0	21	-93	11	11	115	40	
06/23/04	23	24	0	30	66	0	15	-66	10	11	85	42	
06/24/04	24	24	12	21	87	0	6	30	9	11	89	53	
06/25/04	24	24	6	117	72	0	12	-42	10	12	68	90	
06/26/04	24	24	0	6	54	0	3	-18	-	-	-	-	
06/27/04	24	24	6	159	297	0	-6	33	12	16	68	44	
06/28/04	24	24	30	597	1350	0	15	15	13	17	60	42	
06/29/04	21	24	42	474	2292	0	15	-51	14	16	111	40	
06/30/04	24	24	15	210	2262	0	9	-9	12	14	104	40	
07/01/04	24	24	3	78	984	0	-3	27	12	12	141	40	
07/02/04	24	24	3	315	2448	0	0	12	12	13	124	40	
07/03/04	24	24	3	111	849	0	9	-27	12	13	124	40	
07/04/04	24	24	3	30	237	0	15	3	12	13	120	40	
07/05/04	24	24	3	141	381	0	39	27	12	15	80	40	
07/06/04	24	24	24	90	411	0	-39	18	12	14	59	38	
07/07/04	22	24	12	324	831	0	12	-51	10	14	64	39	
07/08/04	24	24	6	255	546	0	-6	72	12	13	37	30	
07/09/04	24	24	3	123	2256	0	-3	6	12	16	43	35	
07/10/04	24	24	18	372	3003	0	3	72	12	16	54	34	
07/11/04	24	24	9	258	2643	51	48	12	13	17	89	31	
07/12/04	24	24	12	567	7518	24	9	36	13	17	100	36	
07/13/04	24	24	3	87	852	12	9	0	15	17	115	30	
07/14/04	24	24	0	234	85	0	9	48	14	17	144	33	
07/15/04	24	24	0	744	4899	0	3	3	14	15	138	34	
07/16/04	24	24	0	80	1446	9	0	18	15	15	138	32	
07/17/04	24	24	0	-48	813	0	0	21	14	15	155	32	
07/18/04	24	24	0	25	2046	16	0	21	14	15	137	35	
07/19/04	24	24	0	84	402	12	3	51	14	17	90	36	
07/20/04	24	24	0	162	1251	6	0	7	14	15	100	35	
07/21/04	24	24	0	195	1245	0	33	12	13	17	70	35	
07/22/04	24	24	0	165	936	3	0	15	14	16	70	30	
07/23/04	24	24	0	120	567	3	15	3	14	16	57	30	

Appendix 1 continued.

	Expanded counts								Water Temp		Gage (cm)		
Date	**hours**	**hours**	Chinook	Chum	Pink	Coho	Dolly	Whitefish	**AM**	**PM**	**Max**	**Min**	**Comments**
07/24/04	24	24	0	357	1749	0	6	27	13	17	59	32	
07/25/04	24	24	0	168	1935	0	-3	45	14	17	66	32	
07/26/04	24	24	0	51	660	3	0	9	14	14	60	32	
07/27/04	24	24	0	15	114	9	0	-6	13	14	74	32	
07/28/04	24	24	0	78	294	45	18	9	13	14	117	36	
07/29/04	24	24	0	75	216	12	12	45	13	16	130	36	
07/30/04	24	24	0	108	405	39	3	57	14	16	122	36	
07/31/04	24	24	0	42	114	36	30	-30	15	15	164	37	
08/01/04	24	24	0	42	207	54	12	6	14	13	171	36	
08/02/04	24	24	0	60	117	33	9	39	12	14	119	35	
08/03/04	24	24	0	57	120	150	9	18	13	14	96	34	
08/04/04	24	24	0	51	123	66	-3	-27	13	15	58	35	
08/05/04	24	24	0	99	75	252	15	-27	12	16	36	36	
08/06/04	24	24	0	120	162	939	21	21	12	16	36	32	
08/07/04	24	24	0	24	96	173	18	-33	13	13	60	32	
08/08/04	24	24	0	9	81	252	0	-6	12	13	60	46	
08/09/04	24	24	0	87	180	282	18	33	13	14	81	37	
08/10/04	24	24	0	126	180	826	0	33	12	16	47	38	
08/11/04	24	24	0	36	114	582	0	-15	13	15	97	42	
08/12/04	24	24	0	36	177	1206	3	39	13	13	104	43	
08/13/04	24	24	0	6	84	747	6	36	13	14	153	65	Water Cloudy
08/14/04	0	0	-	-	-	-	-	-	13	13	175	93	Water Cloudy
08/15/04	0	0	-	-	-	-	-	-	-	-	-	-	Water Cloudy
08/16/04	0	0	-	-	-	-	-	-	-	-	-	-	Water Cloudy
08/17/04	0	0	-	-	-	-	-	-	-	-	-	-	Water Cloudy
08/18/04	0	0	-	-	-	-	-	-	-	-	-	-	Water Cloudy
08/19/04	0	0	-	-	-	-	-	-	-	-	-	-	Water Cloudy
08/20/04	0	0	-	-	-	-	-	-	-	-	-	-	Water Clear
08/21/04	24	24	0	93	0	507	0	72	13	15	63	75	
08/22/04	24	24	0	50	12	1113	9	72	13	15	50	50	
08/23/04	24	24	0	18	24	853	106	24	12	15	59	45	
08/24/04	24	24	0	9	0	577	3	96	12	15	65	45	
08/25/04	24	24	0	0	6	307	6	21	12	14	80	45	
08/26/04	24	24	0	3	16	122	12	30	11	12	73	45	
08/27/04	24	24	0	0	15	504	6	15	10	12	50	45	
08/28/04	24	24	0	0	6	813	9	9	9	11	78	43	
08/29/04	24	24	0	0	12	477	0	30	10	11	80	42	
08/30/04	24	24	0	6	27	327	0	15	10	12	80	39	
08/31/04	24	24	0	6	30	357	3	9	10	11	83	38	Project done